Sound Waves
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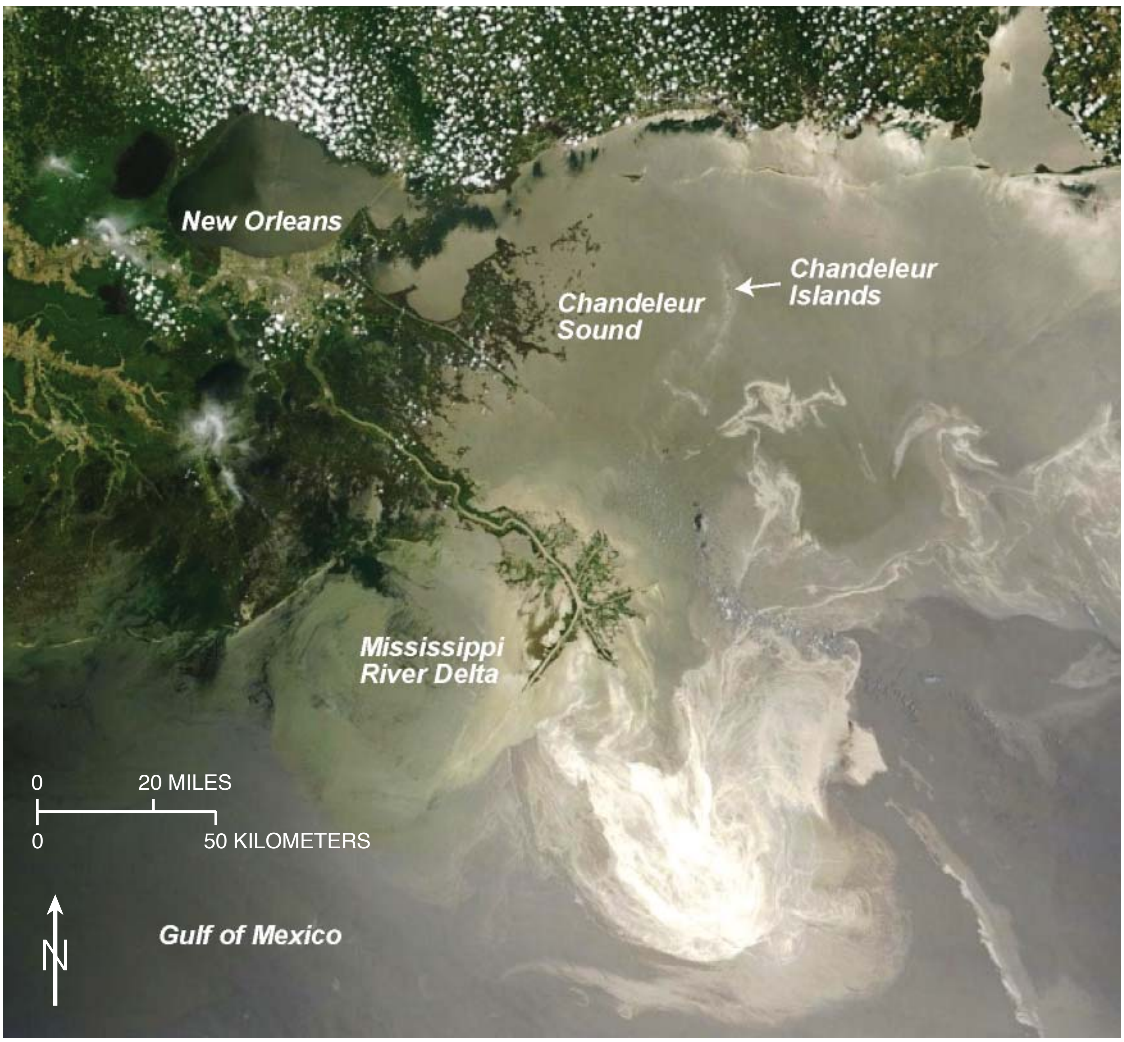
Fieldwork

USGS Scientists Study an Oil-Spill-Mitigation Sand Berm in the Chandeleur Islands, Louisiana

By James Flocks, Christopher Smith, and Jennifer Miselis



MODIS (Moderate Resolution Imaging Spectroradiometer; ***http://modis.gsfc.nasa.gov/****) satellite imagery from May 24, 2010, showing the* Deepwater Horizon *oil spill (light color) approaching the Chandeleur Islands and Louisiana coast.*

The Chandeleur Islands and surrounding Breton National Wildlife Refuge (**http://www.fws.gov/breton/**) provide habitat for a variety of threatened wildlife species, function as recreational areas, and act as storm protection for the vast human infrastructure in coastal Louisiana. Over the past two decades, the islands have become more susceptible to storm-induced breaching and erosion and are undergoing the highest rate of land loss among barrier islands in the Gulf of Mexico. For this reason, the fate of the islands has been the focus of intense study by the U.S. Geological Survey (USGS) and collaborators over the past decade. The most comprehensive studies to date occurred in 2006 and 2007, when projects sponsored by the Louisiana Department of Natural Resources, the U.S. Army Corps of Engineers, and the U.S. Fish and Wildlife Service, in collaboration with the USGS and the University of New Orleans, were conducted to provide a comprehensive characterization of the geology and morphology (shape) of the islands. Results are compiled in a USGS Scientific Investigations Report, “Sand Resources, Regional Geology, and Coastal Processes of the Chandeleur Islands Coastal System: An Evaluation of the Breton National Wildlife Refuge” (**http://pubs.usgs.gov/sir/2009/5252/**).

On April 20, 2010, approximately 130 kilometers (80 miles) southeast of the Chandeleur Islands, the drilling rig *Deepwater Horizon* exploded and oil began discharging from the Macondo MC252 well beneath it. Within 2 weeks, oil was observed at the islands and elsewhere along the Louisiana coastline (see satellite image). By May 2010, in an attempt to protect mainland wetlands, the State

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Sound Waves

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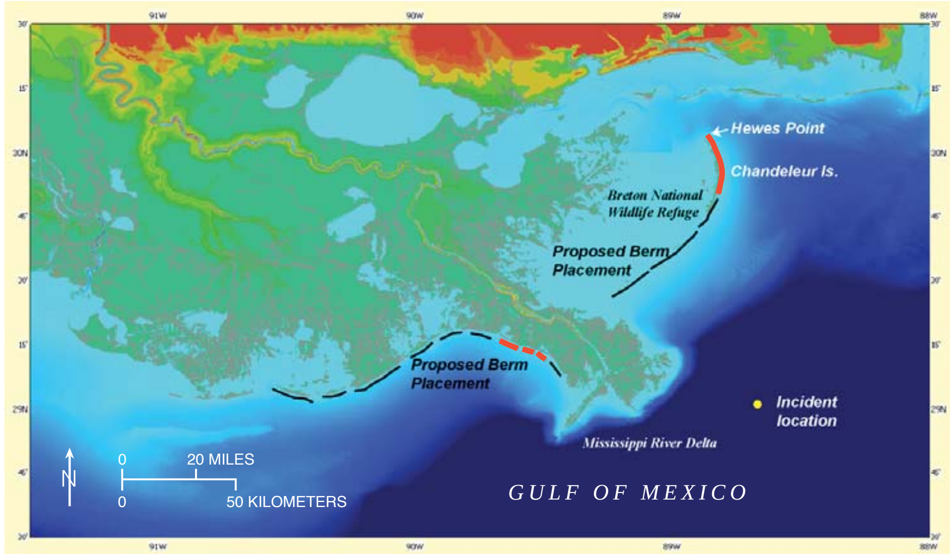

Southern Louisiana and the site of the Deepwater Horizon *oil-spill incident. The State of Louisiana originally planned to build a series of sand berms along the barrier islands to protect the interior marsh from oil contamination. Open segments between individual berms would allow tidal exchange. Black lines represent berms that were proposed but not built; thicker, red lines represent berms that were actually constructed.*

of Louisiana had requested emergency authorization to construct sand berms along the coast to block the movement of oil (see map). At Breton National Wildlife Refuge, the original plan called for the construction of three lengths of berms seaward of the islands that stretched end-to-end from the northernmost island 48 kilometers south to the Mississippi River Delta. To construct the berms, sand would be excavated from a continuous trench 1 kilometer offshore and placed on the island shoreface to produce a mound of sand 182 meters wide at the base and 1.8 meters high at its apex. It was estimated that more than 6.5 million cubic meters of sand would be necessary for construction, making this one of the most ambitious coastal construction efforts in U.S. history. The challenge at this point was to locate such a large amount of suitable sandy material in an otherwise muddy Mississippi River Delta plain.

Through consultation with the USGS and other agencies, it was determined that excavation of material along a linear trench 1 kilometer offshore was not practical and that other sources for the material, such as offshore shoals, were more viable options. This and other concerns were outlined in the USGS Open-File Report, "Effects of Building a Sand Barrier Berm to Mitigate the Effects of the Deepwater Horizon Oil Spill on Louisiana Marshes" (**http://pubs.usgs.gov/of/2010/1108/**). On the basis of data from earlier studies, a large sand resource was identified at Hewes Point, a sand spit building outward from the north end of the barrier-island platform (see sediment-thickness map, next page). Geophysical and coring surveys indicate that the Hewes Point deposit is approximately 27 square kilometers in area and 8 meters thick, and is composed of 97 percent well-sorted fine sand. The formation of Hewes Point at the northern terminus of the Chandeleur Islands was the result of unique geologic conditions. The combination of the island's orientation parallel to the prevailing waves, a centralized source of sandy deposits, and deeper water that allowed sediment to accumulate (called "accommodation space") produced an efficient natural sediment trap that rapidly formed the largest sand body among Louisiana's barrier islands, with a volume of approximately 258 million cubic meters.

With Hewes Point as a source, construction of the sand berm began in June 2010 and continued through March 2011,

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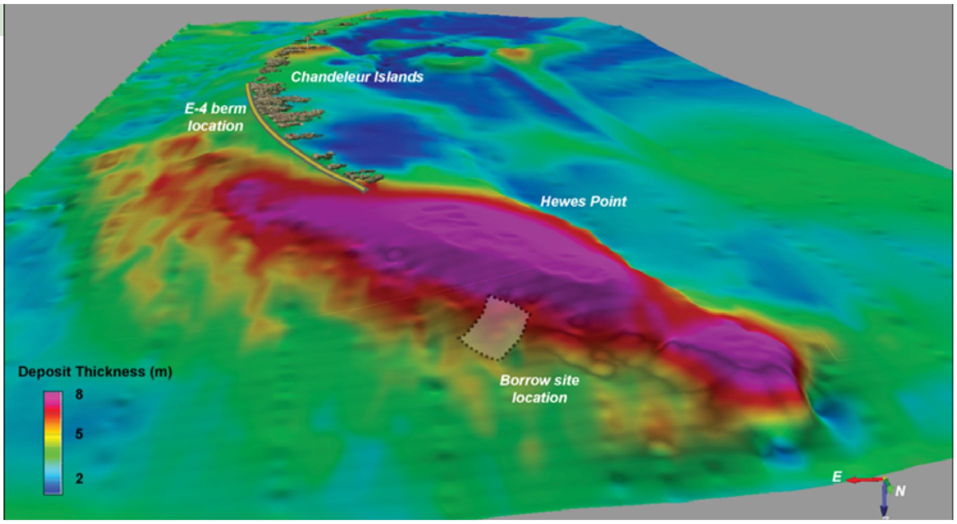

Sediment-thickness map in perspective view (looking south), showing thickness of the sand deposit at Hewes Point, north of the Chandeleur Island chain. Sand used to construct the E-4 berm was excavated from the side of the deposit, about 3 kilometers north of the islands.

*Photograph taken on April 13, 2011, of the completed E-4 berm, which was constructed along the Gulf of Mexico side of the Chandeleur Islands. The berm was detached from the islands for the first 8 kilometers (13 miles), beyond which it was constructed on the beach to reduce required sand volume. Breaches occurred during construction; the one labeled on the photograph occurred January 2010 at the site of a natural inlet. The breach expanded 600 meters in less than one month. Photograph courtesy of the Coastal Protection and Restoration Authority of Louisiana (**http://www.ocpr.louisiana.gov/**).*

long after the Macondo MC252 well had been capped (July15, 2010) and observations of surface oil within the Gulf had ceased (August 2010). In its post-construction form, only the first length (known as E-4) of the originally proposed trio of berms was completed (see aerial photograph, middle right). The E-4 berm extended along the submerged axis of the northernmost Chandeleur Island chain—detached from the islands—for approximately 8 kilometers and joined the island shoreface for an additional 4 kilometers. About 4 million cubic meters of sandy sediment was used in the construction. The berm was engineered as a temporary structure and underwent significant change both during and after construction. Despite a relatively uneventful tropical cyclone season and few significant winter cold fronts, winds and overwash from waves have reduced its elevation and segmented the berm at numerous locations, significantly reducing its subaerial extent (see aerial photograph at right).

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*Oblique aerial photograph from a survey flown by the USGS on March 6, 2012, showing significant breaching of the E-4 berm at several locations and reduced elevations along its entire extent. Image courtesy of **Karen Morgan**, USGS.*

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The berm and the northern Chandeleur Islands provide a natural laboratory of unusually large scale to observe how sudden changes in morphology (for example, due to storms or renourishment projects) and geologic processes (such as erosion, deposition, and rollover—the landward movement of a barrier island as sediment is eroded from the seaward side and deposited on the landward side) will affect barrier-island evolution. With the wealth of scientific data already available for the islands and the fact that the berm will interact with the barrier-island system on observable time scales, the USGS hopes to answer fundamental questions about how climatic and geologic variables influence the present and future morphology of coastal systems. Understanding the physical interactions that drive coastal evolution provides a framework of knowledge for effective management of coastal planning, protection, and restoration. This need prompted a new USGS Coastal and Marine Geology Program project, led by **Nathaniel Plant**, that includes a comprehensive spatial and temporal characterization of the E-4 berm and adjacent waters and islands.

Using satellite imagery, lidar (light detection and ranging) mapping of topography, bathymetric investigations, direct sampling, and numerical modeling, scientists have been monitoring changes along the berm and surrounding environment. From March 22 to 26, 2012, through collaboration with the U.S. Fish and Wildlife Service, a team accessed the berm and islands for direct sediment sampling. On hand were **Kyle Kelso**, **Julie Bernier**, **Marci Marot**, **Carl Taylor**, **Christopher Smith**, and **Jim Flocks** from the USGS St. Petersburg Coastal and Marine Science Center in St. Petersburg, Florida. Several sampling methods were used—surface grab samples, short (approximately 30 centimeter) hand-auger cores, ponar and ekman grab samples, and short (approximately 1 meter) push cores (see photographs at **http://woodshole.er.usgs.gov/openfile/of2005-1001/htmldocs/grab.htm** for examples). In addition, a modified version of the "poking eyeball" camera system (**http://soundwaves.usgs.gov/2003/04/research.html**) was provided by the USGS Pacific Coastal and Marine Science Center (Santa Cruz, California) and the USGS Woods Hole Science Center (Woods Hole, Massachusetts) to collect closeup images of the sediments.

*USGS sampling team preparing to deploy equipment on the Chandeleur Islands. Rapid static Global Positioning System (GPS) instruments mounted on posts recorded sampling positions, normalized to a GPS base station on one of the islands (not shown). Shown in photograph (left to right) are **Kyle Kelso, Julie Bernier, Christopher Smith, Marci Marot**, and **Carl Taylor**. Photograph by **Jim Flocks**, USGS.*

*(Left to right) **Marci Marot, Kyle Kelso**, and **Chris Smith** of the USGS subsampling a push core collected from the Sound side of the Chandeleur Island chain. After sectioning, the samples were kept cool until brought to the laboratory. There, radioisotope and other analyses will determine accretion rates, microfossil assemblages, and physical characteristics. Sampling was conducted from aboard the floating fish camp* Pelican*. Photograph by **Jim Flocks**, USGS.*

The sampling strategy included several components with the intent to monitor change to the berm and islands over time. In the back barrier, short push cores were collected to quantify short-term (seasonal to annual) and long-term (decadal to centennial) sediment movement, as well as to assess sediment storage in the back-barrier environments (marshes, tidal flats, and so on; see photograph of push core, above). Repeat sampling of these back-barrier environments through the duration of the project will provide critical information on how the presence of the berm may influence the storage of sediments. Similarly, grab-sample transects along the axis of the berm were collected to provide snapshots of the physical characteristics of the berm. Repeated sampling of these sites will provide information on how washover and aeolian (wind) processes redistribute the berm sediment. Closeup photographs were also collected to supplement the sampling dataset. Sample transects across the berm and onto the adjacent barrier island will ultimately measure the potential contribution of sediment from the berm to the island shoreface. And finally, reoccupying several sites that were sampled during surveys in 2006 and 2008 will enable comparison of pre- and post-berm physical characteristics (see sample-site map, next page).

Fortunately, distinguishing the berm sediments from the original island sediments is not difficult. The source deposit at Hewes Point is remarkably well sorted,

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*USGS team members examining sediment on the E-4 berm. A, **Carl Taylor** (left) collects a closeup photograph of the berm sediments using the modified "poking eyeball" camera system, while **Julie Bernier** records position. B and C, Example photographs of in-place berm sediments deposited by water (B) and wind (C). D, Short core being extruded from a hand-auger piston. Photographs by **Jim Flocks**, USGS.*

of uniform texture, and devoid of shells. In contrast, the beach sands have high shell content, are mixed with heavy minerals and organic particles, and are finer grained. These characteristics make it possible to differentiate the berm from the island platform. One goal of the study is to identify how these variations between sediment composition of the berm and the island change the natural response of the island system to physical processes. In an ironic twist, since the berm's completion in March 2011, the erosion of the berm is being influenced by the island chain. The northernmost segment of the berm was constructed landward of the now-submerged footprint of the island platform. Hurricanes Georges, Ivan, and Katrina submerged this northern chain of islands at Hewes Point, yet the chain still provides a breakwater that is protecting the berm from overwash. Sands driven by longshore currents are presently prograding (building outward) from the berm along the submerged breakwater, and in places the island platform is re-emerging. Although it contains significant breaches, this segment of the berm has the highest remaining elevation, and aeolian processes currently dominate. South of this segment, where the healthiest islands exist, the central berm is rolling over into the manmade trough that formed between the berm and the islands during construction. This segment exhibits the most promising beach accretion if the unconsolidated berm sediments can resist removal during storms. The southernmost segment of the berm exhibits the highest reduction

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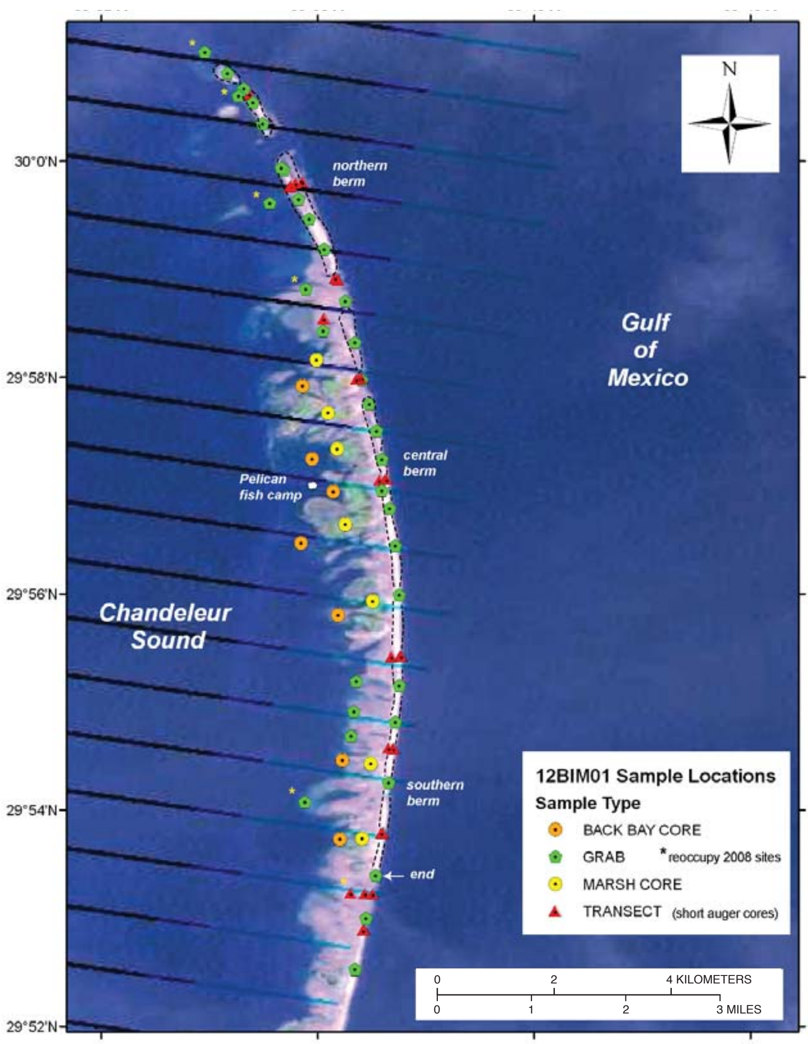

*Landsat imagery from January 15, 2012, with the remnants of the E-4 berm outlined in black dashed lines. Sampling sites shown by sample type. Grab-sample sites (green pentagons) extended along the axis of the berm; grab-sample collection was accompanied by photo surveys. Several grab sites along the Sound side reoccupied sample sites from a pre-berm survey (2008). Short hand-auger cores were collected in transects across the berm and onto the islands. In addition to grab samples, 1-meter push cores (orange and yellow dots) were collected in the back-barrier bay and marsh environments. 12BIM01, project's USGS activity ID (see **http://walrus.wr.usgs.gov/infobank/h/hb112la/html/h-b1-12-la.meta.html**).*

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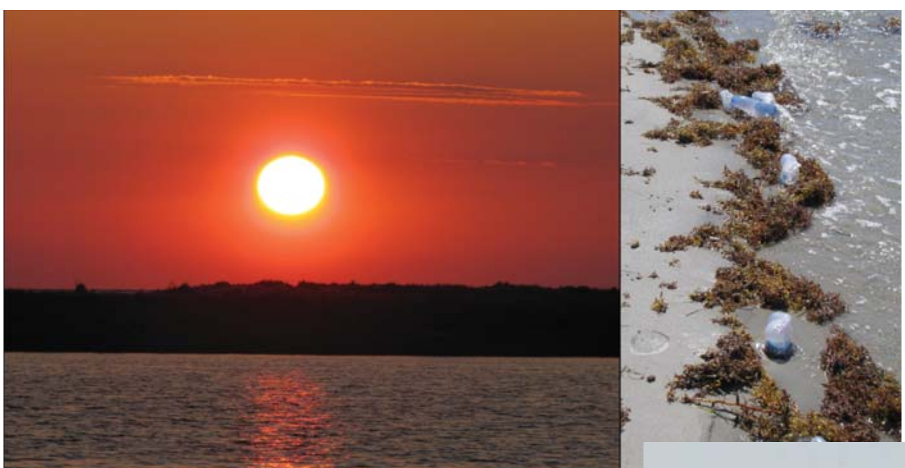
in elevation. Along this reach, islands and dunes are fewer, and overwash splays and inlets are wider. Virtually all of the berm along this reach has been overwashed and eroded and in places has been completely removed.

During their 4-day stay on the islands, the team operated from the floating fish camp *Pelican*, which always welcomes USGS scientists and provides outstanding views of the sunrise and sunset. The team used skiffs to navigate the shallow waters of the back barrier, although sometimes the shallow draft of these boats was not shallow enough. The team successfully circumvented the March 2012 cold fronts, invasion by Portuguese man o' war (*Physalia physalis*), and other challenges typical of work in remote natural environments to complete the survey. The samples the team collected are currently being analyzed, and the team looks forward to integrating results of the study with the other components of the project.

*Photographs of the E-4 berm. A, View across the berm to the adjacent island. The berm was constructed immediately offshore from the original island shoreface, creating a trough that is now infilling with berm sediments through washover and aeolian processes. This segment of the berm is supported by healthy dunes with few inlets and is accreting to the original shoreface, producing an expansive beach. USGS team members **Carl Taylor** (left) and **Julie Bernier** are labeling samples and registering the sample site. B, The southernmost extent of the berm is distinguishable from the island by the berm's lighter sand and little-to-no shell material. Wind and waves have reduced the elevation to original beach height. Photographs by **Jim Flocks**, USGS.*



*Left: Sunrise over the Chandeleur Islands. The remote islands never lack stunning natural views; the marsh and surrounding waters provide habitat for numerous fowl and aquatic species. Right: On the Sound side of the islands, Portuguese man o' war (*Physalia physalis*), whose venomous tentacles can deliver a powerful sting, were washing up onto the shoreline by the thousands. Photographs by **Jim Flocks**, USGS.*

*Small skiffs were used for transportation around the shallow back-barrier waters, and sometimes even their drafts were not shallow enough. The USGS team walked back to the fish camp the day this photograph was taken. Photograph by **Jim Flocks**, USGS.*

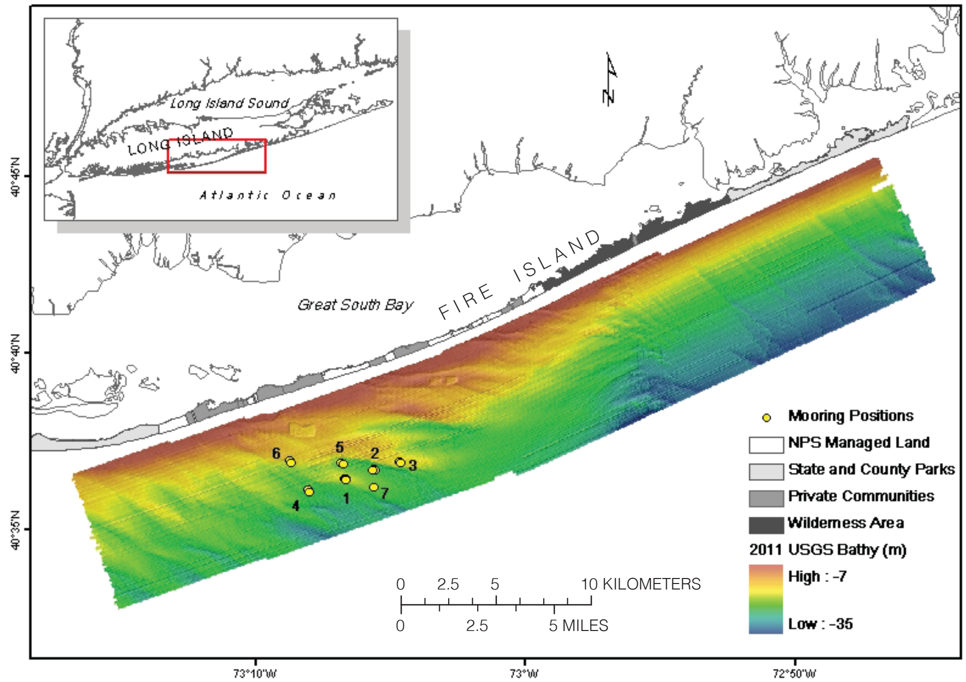
Collecting Ocean-Circulation and Sediment-Transport Data Offshore of Fire Island, New York

By Marinna Martini, John C. Warner, Jeff List, Brandy Armstrong, George Voulgaris (University of South Carolina), and Bill Schwab

Researchers from the U.S. Geological Survey (USGS) Woods Hole Coastal and Marine Science Center (WHCMSC) in Woods Hole, Massachusetts, are collaborating with scientists from Coastal Carolina University and the University of South Carolina to investigate ocean circulation and sediment-transport processes offshore of Fire Island, New York. Although the investigation encompasses the linear extent of Fire Island (approximately 50 kilometers, or 30 miles), one main study area is near the western end of the island where offshore sand ridges extend across the inner continental shelf and connect to the nearshore bar system. These ridges are on the order of 5 to 10 kilometers long and are spaced several kilometers apart, oriented obliquely to the coastline (see map). The USGS mapped these features at high resolution in 2011 to provide detailed bathymetry, subsurface structure, and surface texture. It is hypothesized that the ridge field modifies surface waves from storms, causing a complex wave pattern that reaches the coastline and influences sediment-transport and coastal-erosion patterns.

This study is part of a larger effort in cooperation with the U.S. Army Corps of Engineers (USACE) and the National Park Service (NPS) to study coastal processes on Fire Island. The offshore efforts described here were coordinated with nearshore beach surveys to assess coastal change during winter storms (see NPS news release at **http://www.nps.gov/fiis/parknews/usgs-continues-coastal-research-off-fire-island-during-winter-2012.htm**).

To investigate the ocean circulation and wave-refraction patterns across the offshore sand ridges, several instruments were positioned on the seafloor in lines along the ridge crests and in lines that crossed the crests and troughs (see map). Site 1 at the top of a ridge and site 2 at the bottom of the adjacent trough were each populated with two tripods holding similar instruments. At each of the rest of the sites, we placed a single tripod holding fewer instruments. Surface buoys were deployed at sites 1 through 6 to mark the tripod locations and to serve as platforms for surface measurements.



USGS study sites off Fire Island, New York, positioned both along the ridge crest and across the crests and troughs of the ridge system. Bathy, bathymetry; m, meters.

Measurements and Sensors

The primary objective was to measure current speed and direction, temperature, salinity, surface waves, bottom stress (the force created at the seabed by currents and waves; see related *Sound Waves* article at **http://soundwaves.usgs.gov/2012/04/research3.html**), and suspended sediment along and across the ridges. This deployment was similar to previous efforts, such as a 2009 deployment off Cape Hatteras, North Carolina (**http://soundwaves.usgs.gov/2009/04/fieldwork3.html**). The instruments placed at sites 1 and 2 were designed to provide high-resolution measurements near the seafloor to record events in which seafloor sediment may be resuspended by strong currents associated with storms. Because most of these measurements can be made

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USGS Woods Hole Coastal and Marine Science Center staff preparing a flow tripod (flobee) for deployment from the R/V Connecticut*.*

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only in unobstructed flow, 3.5-meter-high flow tripods (flobees) were deployed at sites 1 and 2 to provide measurements at various heights off the seabed and at a high sampling frequency within 3 meters of the seabed. Each flobee included a conductivity/temperature/depth (CTD) sensor, an acoustic Doppler velocimeter to measure current speed and direction at a single point with high accuracy and sampling rate, and a current profiler to measure current velocities over a range of depths. Sediment resuspension was measured by both optical (transmission and backscatter) and acoustic techniques. Pressure was also measured.

Measurements that would interfere with sensors on the flobee were made from a smaller tripod (minipod) deployed alongside the flobee. The minipod measurements included sonar images (overhead views) and sonar profiles (side views) of the seabed surface, as well as current-velocity profiles of current speed and direction over the entire water column. The minipod at site 1 also included a still camera for taking photographs at regular intervals ("time series") to document seabed changes and a laser backscatter system to measure sediment size.

Surface buoys were deployed at sites 1 through 6 primarily to mark the position of the bottom equipment. Surface salinity was measured at each buoy by Seabird MicroCAT recorders. At site 2, the buoy was fitted with a weather station that measured barometric pressure, wind speed and direction, humidity, air temperature, and solar irradiance.

New Techniques

This deployment was a rare opportunity for the WHCMSC to perform long-term testing of some new methods and equipment. For example, the weather-buoy system is being evaluated as a tentative step toward further development of telemetered (wirelessly transmitted) data. During the 2009 work off Cape Hatteras, we learned that weather measurements from other sources were inadequate and that we needed to measure local atmospheric data using simple, inexpensive, portable systems that could be deployed at sea and on land at critical locations. We are investigating the use of telemetry so that if these measurements are made during a large storm, such as a hurricane, that might put the buoy adrift, the buoy can still be recovered, and, more importantly, much of the data will already be safely in hand. The system deployed off Fire Island was built to WHCMSC specifications by Down East Instrumentation. It was modeled on a Carolinas Regional Coastal Ocean Observing System (**http://carolinasrcoos.org/**) design that proved itself in the early 2000s as part of the larger east-coast monitoring network.

Small tripod (minipod) aboard the R/V Connecticut*, just before entering the water at site 1.*

We are also testing a new technique for inhibiting biofouling (the accumulation of organisms, such as algae or barnacles, on submerged surfaces), which has long been a challenge when making long-term coastal and continental-shelf measurements. As new studies by the WHCMSC bring operations into ever-shallower waters, the need for better anti-fouling techniques becomes more urgent. Older methods that used biocides are a hazard to the environment and to the people who handle the gear. During the 2009 Cape Hatteras deployment and during fieldwork by the USGS Pacific Coastal and Marine Science Center (PCMSC) in Santa Cruz, California, a customizable Zebra-Tech wiper system was successfully tested on the optical backscatter sensor. More wipers were acquired for the Fire Island deployment. Zebra-Tech's system consists of a brush attached to an actuator that is plugged into a battery pack with a timer. The timer can be set to pass the brush across the face of the sensor at a predetermined interval of minutes to hours. For transmissometers, the WHCMSC had previously developed a method of preventing fouling with biocide-impregnated rings. As an alternative, **Ray Davis** (WHCMSC) developed a prototype wiper for WET Labs C-Star transmissometers that could be fitted to a Zebra-Tech actuator. The wiper was successfully tested in Buzzards Bay,

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Weather buoy being towed behind the R/V Connecticut *into position just before dropping the mooring's anchor.*

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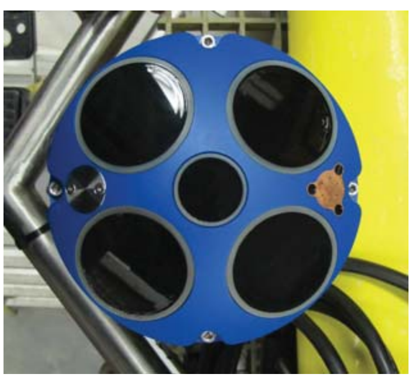
Massachusetts, as well as off the U.S. west coast (by the PCMSC). **Emile Bergeron** (WHCMSC) improved the design and made more units for this deployment.

Additional new work includes the testing of new equipment for possible replacement of existing gear. Some of the standard instruments on which the WHCMSC has relied over the past decade are reaching the end of their service life or have been discontinued by their manufacturers, including many of the current-velocity profilers, the acoustic-backscatter profiler, the optical-backscatter sensors, acoustic releases, and the system that logs sonar images and profiles. A newly designed acoustic Doppler current profiler Sentinel V model from Teledyne RD Instruments (TRDI) was recently acquired and was deployed alongside the old TRDI Workhorse profiler; it will also be compared to two Nortek AWAC systems deployed at other sites.

Sonar imaging is becoming a standard measurement for the WHCMSC, and the recent deployment will allow comparison of sonar bottom images and profiles

*Brushes made by **Emile Bergeron** (WHCMSC) to keep transmissometer lenses clean are connected to an off-the-shelf Zebra-Tech wiper system. The brushes pass across the optical windows at 3-hour intervals. The rest of the sensor is covered in copper tape to prevent biological growth that might extend into the sensing volume or impede the motion of the brushes.*



TRDI Sentinel V current profiler mounted at the top of the flobee tripod at site 1. Data from the profiler will be compared to data recorded by a TRDI Workhorse profiler on the neighboring minipod, as well as to data recorded by Nortek AWAC profilers at an adjacent site.

from site 1 (at the top of a ridge) and site 2 (in an adjacent trough). Imaging sonars generate a picture of the seabed showing bed morphology (shape) over time and the direction of ripple movement. More accurate information about the height and wave-length of ripples is measured by profiling sonars, which provide a side view, or profile, of the seabed surface. To measure ripple height and wave length over a greater spatial area, the profiling sonar head must be rotated in a horizontal plane using an azimuth drive. The sonar logging system deployed at site 1 has these abilities and thus provides a unique system. Made for the USGS in 2000 and never commercialized, this system is at the end of its service life. To duplicate the measurements at site 2 and test a replacement for the older system, the WHCMSC borrowed an imaging sonar system and acquired an ASL Environmental Sciences IRIS sonar logging system and Imagenex profiling sonar. At the center's request, ASL added azimuth drive capability to the IRIS to rotate the profiling sonar.

Preparation and Deployment

From mid-November 2011 through mid-January 2012, numerous WHCMSC personnel spent time at the Marine Operations Facility to build the nine tripods and prepare the parts for the six buoy moorings. We would like to thank **Brandy Armstrong** for keeping track of all the instrumentation, how it was programmed and where it went, frame assembly, and instrument mounting; **Sandy Baldwin** for instrument assembly, mounting, and photography; **Robert Barton** for help with anchor assembly; **Emile Bergeron** for case mounts, wiper brushes, and various other parts and mounts that had to be handmade at the last minute; **Phillip Bernard** for help with tripod transportation and ship contracting; **Dann Blackwood** for instrument mounting, camera and SEABOSS preparation, and tripod transportation; **Jonathan Borden** for just about everything; **Soupy Dalyander** for stuffing battery cases; **Patrick Dickhudt** for preparing the LISST suspended-sediment sensor and tripod transportation; **Barry Irwin** for setting up a bathymetric data and navigation station for the cruise; **Jeff List** for helping with site selection and experimental design, stuffing battery cases, and mounting instruments; **Marinna Martini** for project management and instrumentation preparation; **Ellyn Montgomery** for sonar testing, programming, weather-station-system testing, telemetry and telephone-system wrangling, and other general help; **Jeff Obelcz** for instrumentation mounting; **Chris Sabens** for coming in to direct others even when she could use only one hand; **Chuck Worley** for SEABOSS preparation; and **John Warner** for serving as Chief Scientist.

All of the equipment was deployed off Fire Island in two round trips from January 23 to 26. **Jonathan Borden** led **Brandy Armstrong**, **Sandy Baldwin**, **Jeff List**, **Marinna Martini**, **Ellyn Montgomery**, **Jeff Obelcz**, **John Warner**, and **Chuck Worley** aboard the research vessel (R/V) *Connecticut* to deploy the six buoys and nine tripods. Bathymetric survey data produced by the WHCMSC in 2011 and depth readings taken on site were used to finalize the positions. The SEABOSS (**http://woodshole.er.usgs.gov/operations/sfmapping/seaboss.htm**) was used to make visual surveys of the seabed and take sediment samples.

All of the gear was recovered aboard the R/V *Connecticut* in April 2012, and analysis of the data is underway. We thank the crew of the R/V *Connecticut* for their support, and the PCMSC, the University of South Carolina, and the Woods Hole Oceanographic Institution for providing additional equipment for the deployment.

Tenth Triennial Open House in Menlo Park, California

By Helen Gibbons

*USGS marine scientist **Peter Triezenberg** and USGS Volunteer for Science **Karla Knudson** staff a welcome table. Photograph by **Mike Diggles**, USGS.*

*Bald Eagle "Sequoia" stretches her wings as her trainer, San Francisco Zoo volunteer **John Flynn**, fields questions from visitors. Photograph by **Jenna Stanley**, USGS Volunteer for Science.*

An estimated 5,000 to 7,000 visitors explored more than 85 exhibits on the U.S. Geological Survey (USGS) campus in Menlo Park, California, during its 10th Triennial Open House on May 19 and 20, 2012. **Jeff Keay**, Acting Regional Executive for the USGS Southwest Area, toured the Open House on Saturday and later wrote that "the breadth of USGS science displayed, the highly interactive activities, the engagement of all ages of visitors, the support of our partners, and, perhaps most of all, the enthusiasm of our scientists were a testament to a great science organization."

Many exhibits touched on coastal or marine themes:

- **Science Behind Tsunamis:** Geophysicist **Eric Geist** and USGS Volunteer for Science **Anne Rosenthal** created a Tsunami Scientist Training Center where visitors learned how tsunamis work and how to maximize their safety during a tsunami. Explore USGS tsunami information at **http://walrus.wr.usgs.gov/tsunami/**.
- **Fly Over the Seafloor:** Using USGS bathymetric data, **Pete Dartnell** took visitors on virtual flights through the underwater terrain of San Francisco Bay, Lake Tahoe, and Monterey Bay. View these areas and more at **http://walrus.wr.usgs.gov/pacmaps/**.
- **Sea Otter Research**: Visitors touched sea otter pelts and skulls, handled tracking equipment, and learned about what sea otters eat at an exhibit hosted by **Joe Tomoleoni** (University of California, Santa Cruz) and other scientists from **Tim Tinker's** lab at the USGS Western Ecological Research Center (WERC). Learn more at **http://www.werc.usgs.gov/project.aspx?projectid=221**.
- **Bald Eagle from the San Francisco Zoo:** "Sequoia," whose damaged tail prevents her from living in the wild, represented Bald Eagles that are recovering from DDT exposure and once again nesting in the Channel Islands off southern California, thanks to efforts by the National Oceanic and Atmospheric Administration (NOAA), the USGS, the San Francisco Zoo, and other partners (**http://www.montroserestoration.gov/restoration/bald-eagles/**). She was accompanied by **Kathy Hobson** of the zoo's Avian Conservation Center and zoo volunteer **John Flynn**.
- **Topo Salad Trays:** Ordinary topographic maps of Angel Island (in San Francisco Bay) and Monterey Canyon (beneath Monterey Bay) took three-dimensional shape as visitors stacked transparent plastic trays with one contour line on each. At a do-it-yourself counter, exhibit lead **Helen Gibbons** (USGS) and others helped kids trace

(Open House continued on page 11)

*Visitors pan for gold at an exhibit presented by the California Geological Survey (read about gold at **http://www.conservation.ca.gov/cgs/geologic_resources/gold/Pages/**). Photograph by **Mike Diggles**, USGS.*

(Open House continued from page 10)

*USGS marine scientist **Amy Foxgrover** helps a young Open House visitor trace a contour line onto a blank plastic tray at the Topo Salad Trays display. Photograph by **Florence Wong**, USGS.*

contour lines onto blank trays (see **http://online.wr.usgs.gov/outreach/topo_instructions.html**).

- **Dress Like a Scientist:** Formerly called "Dress Like a Marine Geologist," this popular activity, headed by USGS geographer **Dario Garcia**, invited visitors to put on field attire and pose for a photograph in a field or laboratory setting of their choice. View the results at **http://openhouse.wr.usgs.gov/2012/photoIndex.html**.
- **South Bay Salt Pond Restoration Project:** Visitors heard the latest about this multiagency project—the largest tidal-wetland-restoration effort on the U.S. west coast—from lead scientist **Laura Valoppi** (USGS) and others. Wetlands provide important habitat and can help protect against rising sea levels associated with climate change; learn more at **http://www.southbayrestoration.org/**.
- **Don Edwards San Francisco Bay National Wildlife Refuge:** Led by **Doug Cordell** of the U.S. Fish and Wildlife Service, staff and volunteers from this 30,000-acre wildlife habitat along the southern reaches of San Francisco Bay told visitors about recreational opportunities, environmental education, and cutting-edge scientific research at the refuge (**http://www.fws.gov/desfbay/**).
- **Extreme Microbes!:** Scientists led by **Shelley Hoeft** and **Jodi Blum** (both USGS) taught visitors about the extreme environment of Mono Lake—which is too salty and alkaline for fish to survive—and the adaptations that microorganisms must make to live there. Learn more at **http://microbiology.usgs.gov/geomicrobiology.html**.
- **How Clean Is Clean?:** This hands-on activity headed by **Jim Kuwabara** (USGS) demonstrated the link between electrical conductivity and water quality. Learn more at **http://wwwrcamnl.wr.usgs.gov/solutetransport/**.
- **The Community Living in a Drop of Water from San Francisco Bay:** Scientists headed by **Tara Shraga** (USGS) invited visitors to view the microscopic plants and animals that inhabit San Francisco Bay. Learn more about San Francisco Bay water quality at **http://sfbay.wr.usgs.gov/access/wqdata/**.
- **Jon Boat:** Visitors climbed into a flat-bottomed Jon boat, put on life vests, and pretended they were USGS scientists mapping the seafloor in very shallow water. See an example of such work at **http://sofia.usgs.gov/publications/ofr/02-325/methods.html**.
- **LiDAR (Light Detection and Ranging):** Visitors were scanned by a terrestrial lidar instrument, which uses laser light to create high-resolution, three-dimensional images. Presented by **Skye Corbett** (USGS) and **Diane Minasian** (USGS Volunteer for Science), the exhibit explained some of the many uses of lidar, including documenting landscape change. Read about examples at **http://pubs.usgs.gov/fs/2006/3111/**.

(Open House continued on page 12)

*Young visitors pose (above) for scanning by a terrestrial light detection and ranging (lidar) instrument, which uses laser light reflected from surfaces to create high-resolution, three-dimensional images (right; slightly different pose). Lidar data are particularly useful for documenting landscape change, such as hurricane damage and coastal-cliff erosion. (The scanner uses a Class 1 laser, which poses no threat to the naked eye.) Photographs by **Mike Diggles**, USGS.*

(Open House continued from page 11)

- **What Can Deep Sediment Cores Tell Us About Mercury Pollution?: Mark Marvin-DiPasquale** (USGS) and others showed visitors samples from a sediment-coring project designed to estimate how much toxic mercury is in Alviso Slough in south San Francisco Bay (see **http://microbiology.usgs.gov/geomicrobiology_mercury.html#san_fran_restoration**).
- **What's the USGS Doing in the Sacramento-San Joaquin Delta?:** Headed by **Dan Ponti** (USGS), this exhibit acquainted visitors with California's Sacramento-San Joaquin Delta and a collaborative geologic study of the Delta recently begun by the USGS and the California Department of Water Resources.
- **Live Music:** Performances by amateur musicians from the USGS and other groups added to the fun.

Many thanks to the exhibitors named above and to the additional contributors—too numerous to name—who helped with preparation, setup, teardown, and staffing. Visitors loved the Open House and were impressed with the knowledge, professionalism, and enthusiasm of all the scientists, volunteers, and support staff. Organizer **Christy Ryan** reported such feedback as "What an awesome and fun public event … great for people of all ages!" and "You should hold these events every year!"

For more information about the Open House, including a full list of exhibits and a photo gallery, visit **http://openhouse.wr.usgs.gov/**. ❁

Visitors study information at the Tsunami Scientist Training Center while USGS geophysicist ***Eric Geist*** *(back left) fields questions. Photograph by* ***Jenna Stanley****, USGS Volunteer for Science.*

Open House participants find fun and excitement posing before Hollywood-style backdrops at the Dress Like a Scientist exhibit. Photographs by ***Dario Garcia****, USGS. (See more photographs at* ***http://openhouse.wr.usgs.gov/2012/photoIndex.html****.)*

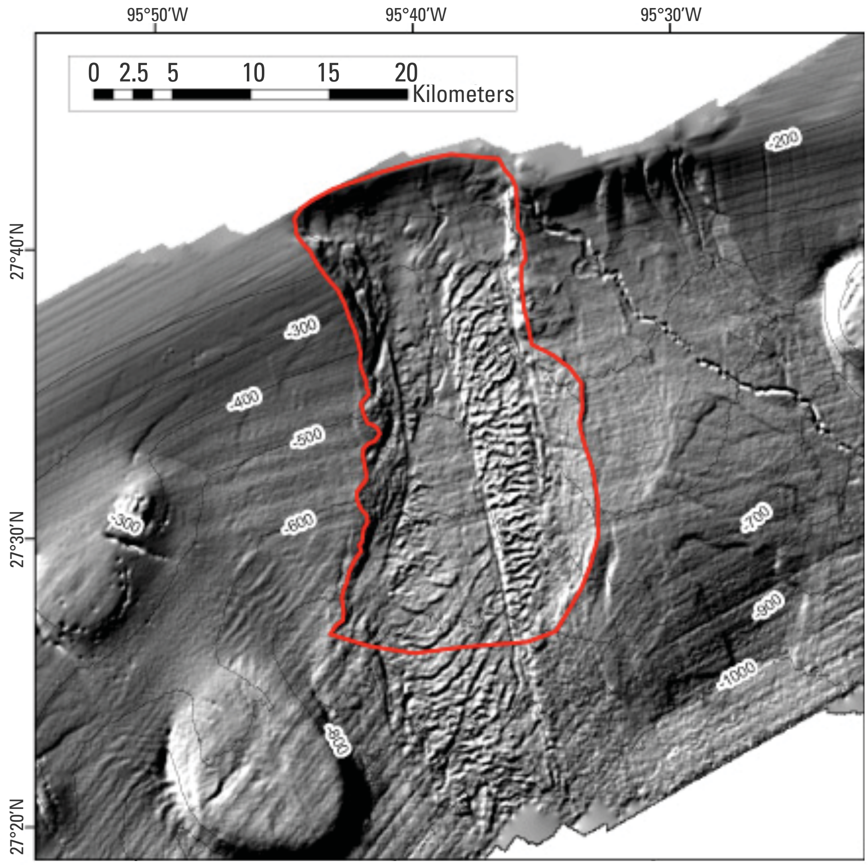
Joint Nuclear Regulatory Commission/U.S. Geological Survey Workshop on Probability of Landslide-Generated Tsunamis

By Eric Geist and Uri ten Brink

Nuclear accidents caused by the massive tsunami that struck Japan in 2011 were grim reminders that nuclear power plants along U.S. coastlines must be assessed for both earthquake and tsunami hazards. Most tsunamis are generated by earthquakes, submarine landslides, or a combination of both. Currently, the U.S. Nuclear Regulatory Commission (NRC) evaluates earthquake hazards using probabilistic methods, that is, determining the probability that a certain level of ground motion will be met or exceeded in a given period of time. In contrast, the NRC evaluates tsunami hazards by determining the "worst-case" scenario, which is independent of time. Ongoing research is exploring whether tsunami hazards can be evaluated probabilistically at the design probabilities of interest to the NRC (typically, an annual probability of 1/10,000 or 1/100,000).

The significant obstacle in calculating tsunami severity at very low probabilities is the need to include submarine landslides as well as earthquakes in the analysis. Information on how often submarine landslides occur is uncertain or altogether lacking in some regions, resulting in high uncertainty in the probabilistic analysis of tsunami hazards in comparison with the probabilistic analysis of earthquakes.

For the past several years, the U.S. Geological Survey (USGS) has done research to identify and date significant submarine landslides along the U.S. Atlantic margin and in the Gulf of Mexico-Caribbean region. For example, see "Submarine Landslides as Potential Triggers of Tsunamis That Could Strike the U.S. East Coast," *Sound Waves*, August 2009, **http://soundwaves.usgs.gov/2009/08/fieldwork.html**, and "Gravity Coring Offshore Puerto Rico and the U.S. Virgin Islands to Investigate the Timing of Submarine Landslides and Large Earthquakes," *Sound Waves*, July 2008, **http://soundwaves.usgs.gov/2008/07/fieldwork3.html**.



*Shaded-relief bathymetric image of East Breaks Landslide, a submarine landslide off the coast of Texas in the Gulf of Mexico (see map of Gulf of Mexico submarine landslides, next page). Water-depth contours in meters. The source area of material that slid is outlined in red. Image from workshop presentation by **David Twichell**, USGS (retired).*

Recent efforts have focused on how submarine-landslide probability might be determined using available geological and geophysical information and on identifying the challenges of incorporating this information into the determination of tsunami probabilities. To address these issues, a joint "NRC/USGS Workshop on Landslide Probability" was held August 18–19, 2011, at the USGS Woods Hole Coastal and Marine Science Center in Woods Hole, Massachusetts. Academic, industry, and government participants provided an overview of topics including geological characterization of submarine landslides, geotechnical techniques and measurements of slope stability, hydrodynamic modeling of landslide-generated tsunamis, and probabilistic methods for hazard assessment. In attendance from the NRC were **Annie Kammerer** from the Office of Nuclear Regulatory Research and **Henry Jones** from the Office of New Reactors. The goal of the workshop was to bring together experts who study the geometry, geotechnical properties, and recurrence of submarine slope failures, the potential of these failures to generate tsunamis, and the probability of recurrence of extreme events, in order to answer the following questions:

- Using current data, what can we say about the probability of submarine mass failures (landslides)?
- How do we treat the dynamics of landslide movement probabilistically?

(Landslide Tsunamis continued on page 14)

(Landslide Tsunamis continued from page 13)

- How do we treat propagation (travel through the ocean) and runup (flooding to a given elevation on land) of tsunami waves probabilistically?
- What new probabilistic methods can be developed specifically for submarine mass failures?

Although probability is mentioned in all of these questions, a probabilistic assessment is only as good as the underlying data and assumptions; therefore, it is critical that we address the state of knowledge and the kinds of new data that will be needed to improve our ability to estimate the probability of landslides capable of generating tsunamis.

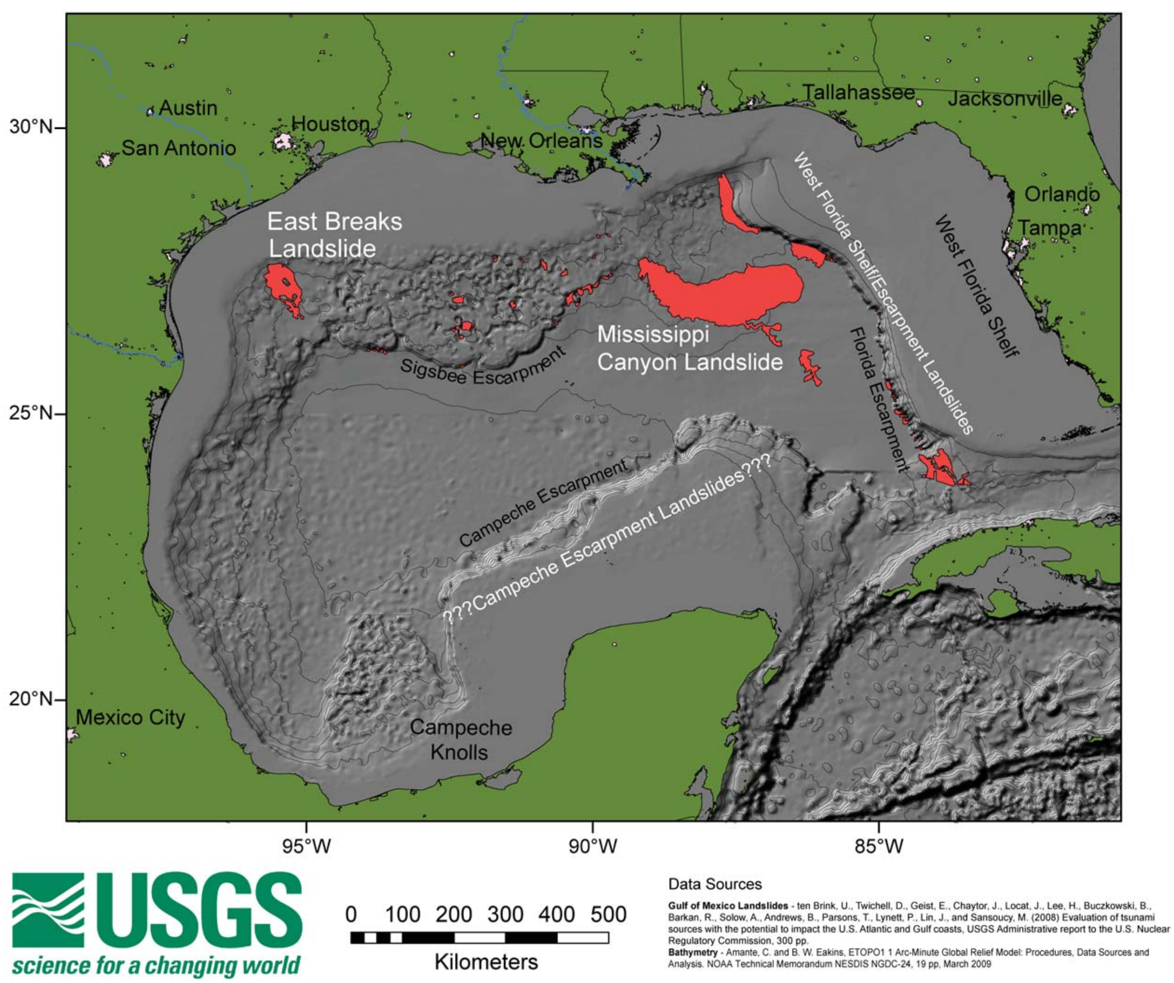
Workshop participants summarized the state of knowledge regarding the probability of landslide-generated tsunamis, particularly along the U.S. Atlantic and Gulf of Mexico coasts. Presentations were grouped into four sessions: (1) landslide geometry and recurrence, (2) landslide mechanics, (3) modeling landslide-generated tsunamis, and (4) probability of landslides and landslide-generated tsunamis.

The landslide geometry and recurrence session included an overview talk by USGS emeritus scientist **Homa Lee** on how submarine landslides are identified (including potential pitfalls) and an overview of mapped landslides in the Gulf of Mexico and U.S. Atlantic margins by USGS scientist **David Twichell**. Details of various techniques used to date submarine landslides and sediment-transport processes associated with landslides were given by USGS scientists **Jason Chaytor** and **Daniel Brothers**, respectively.

The first three talks in the landslide mechanics session focused on geotechnical characterization of slope stability, including a technique for determining the likelihood of landslide occurrence given information on earthquake ground-shaking probabilities and bathymetric slope, presented by **Uri ten Brink**, USGS. **Don DeGroot**, University of Massachusetts Amherst, described state-of-the-art instrumentation to provide geotechnical characterization of the seafloor. An overview of geotechnical considerations for landslide occurrence was given by **Jacques Locat**, Université Laval, Québec, followed by a presentation of a newly developed numerical model for simulating landslide dynamics by **David George**, USGS.

The session on modeling landslide-generated tsunamis focused on state-of-the-art hydrodynamic modeling of long- and intermediate-length waves associated with this unique type of tsunami. **Juan Horrillo**, Texas A&M University at Galveston, compared conventional two-horizontal-dimension (2HD) models with three-dimensional (3D) models. Labora-

(Landslide Tsunamis continued on page 15)

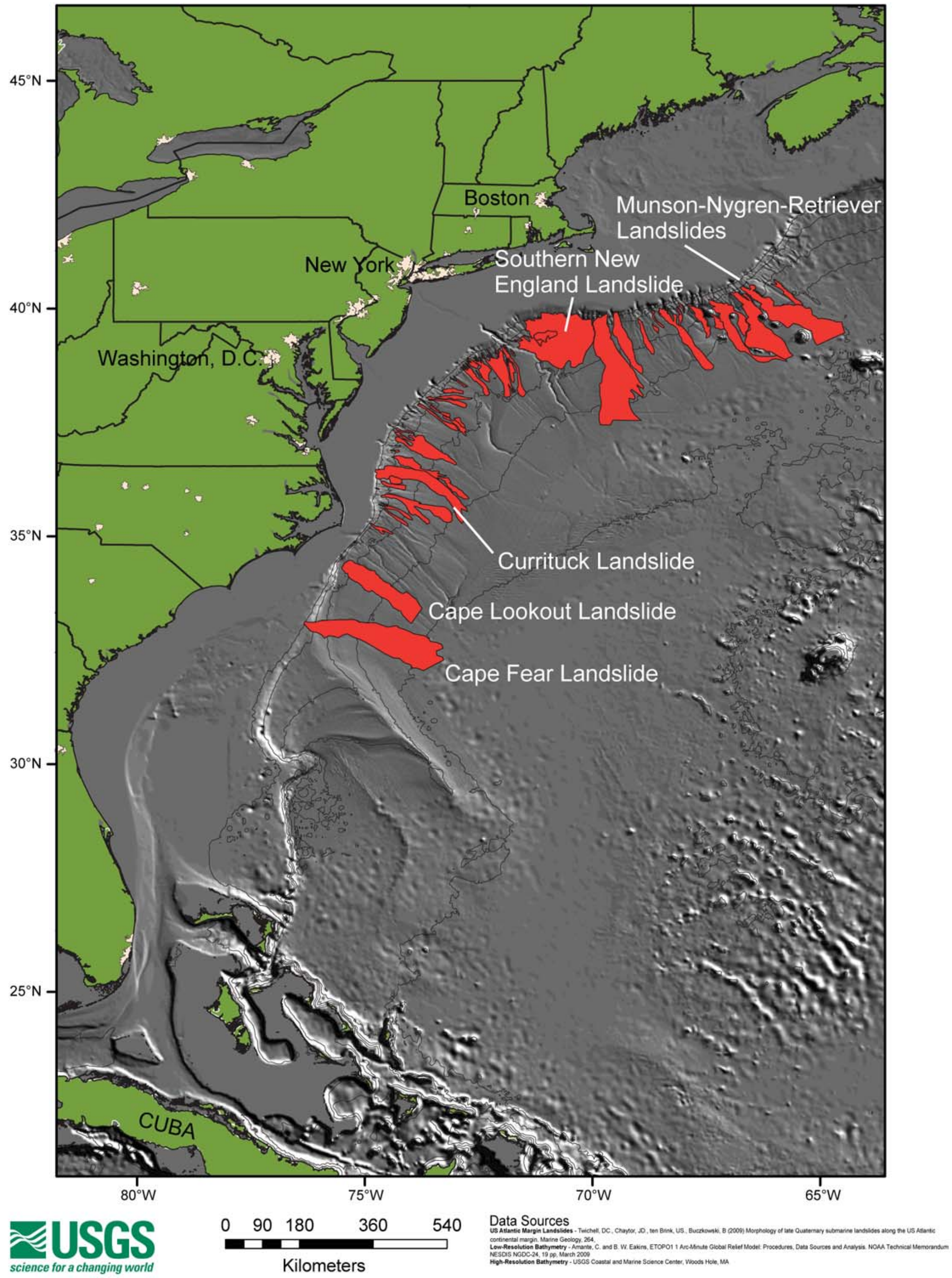


Map of Gulf of Mexico submarine landslides (red). Slightly modified from figure provided by ***Jason Chaytor****, USGS.*

(Landslide Tsunamis continued from page 14)

tory experiments used to validate hydrodynamic models were described by **Stéphan Grilli**, University of Rhode Island. **Patrick Lynett**, University of Southern California, used nonlinear Boussinesq-type models to show how probabilistic variations in down-slope landslide length can be evaluated. For the final presentation in this session, **Frank González**, University of Washington, showed how numerical hydrodynamic models are used in probabilistic tsunami hazard analysis (PTHA), providing a transition to the final session of the workshop.

The session on probability of landslides and landslide-generated tsunamis began with a presentation by **Hong-Kie Thio**, URS Corporation, about how probabilistic tsunami hazard analysis has been applied in the Pacific Basin and how disaggregation (percentage contribution of different sources) can provide important information about which source regions dominate the probabilistic calculations. A version of probabilistic tsunami hazard analysis specific to submarine landslides was presented by **Christopher Baxter**, University of Rhode Island, in which geotechnical calculations were combined with knowledge of how tsunami amplitude correlates with the size of the landslide to estimate tsunami hazards for the U.S. east coast. A method to determine landslide probabilities over a broad region by using seafloor databases, such as usSEABED (see related *Sound Waves* article at **http://soundwaves.usgs.gov/2006/05/research.html**), was presented by **Eugene Morgan**, Duke University. **Eric Geist**, USGS, synthesized the results of the workshop into a presentation about the approaches and challenges of incorporating submarine landslides into probabilistic tsunami hazard analysis. **Annie Kammerer**, NRC, then talked about the challenges facing the NRC in providing guidelines to power companies for tsunami-hazard mitigation.



*Map of submarine landslides (red) off the U.S. Atlantic coast. Slightly modified from figure provided by **Jason Chaytor**, USGS*

The workshop presentations provided a summary of current thinking related to submarine landslides, their probability, and the complex hydrodynamics of landslide-generated tsunamis. Consensus from the presentations and discussion was that acquisition of additional geological and geophysical data, particularly age-dates from past landslide events, is necessary before probabilistic tsunami hazard analysis can be conducted at NRC-relevant design probabilities. However, probabilistic and statistical methods using available site-specific and regional geologic data can yield estimates of, for example, the probability associated with the "worst-case" scenario. ☸

Meeting of Experts on Key Drivers of Central California Coastal Change and Inundation Due to Climate Change

By Curt Storlazzi

Over the past year, a number of federal, state, and local governments, along with research institutions and nonprofit organizations, have met several times, in different combinations, to address adaptation to climate change along the coast of California. There has been great demand for understanding the local impacts of future sea-level rise and coastal inundation in order to develop adaptation strategies that can be incorporated into local planning. Although these meetings have determined how the different agencies should deal with climate change, it has become evident that a clear understanding of the local and regional impacts of climate change is still lacking—specifically, how sea-level rise, storms, and inundation will manifest themselves and impact the coast. To help address these issues, the U.S. Geological Survey (USGS) Pacific Coastal and Marine Science Center (PCMSC) partnered with Moss Landing Marine Laboratories (MLML) and Stanford University's Center for Ocean Solutions (COS) to hold a workshop bringing together experts on climate change and the relevant physical processes that will impact the central California coast in the future.

On Wednesday, May 16, 2012, **Larry Breaker** (MLML) hosted the workshop at Moss Landing Marine Laboratories, with funding provided by the Center for Ocean Solutions. The goal of COS's Climate Change Initiative is to bring the research and decision-making communities together to advance the collective understanding of the expected impacts of climate change on ocean and coastal systems, to improve the translation of that knowledge into actionable concepts, and to incorporate it into adaptation decision making and funding programs. **Larry Crowder** (COS Science Director) and **Adina Abeles** (COS Director of Education and Training) provided overall guidance and support for the workshop. **Curt Storlazzi** (USGS-PCMSC) led the workshop and developed the science agenda with **Patrick Barnard** (USGS-PCMSC).

***Curt Storlazzi** (USGS, standing) addressing workshop participants including (left to right) **David Jay** (Portland State University), **Patrick Barnard** (USGS), and **Larry Breaker** (Moss Landing Marine Laboratories).*

The workshop's morning session was a review of the latest understanding (including quite a bit of "in press" work) of modeled climate-change impacts on the key drivers of coastal change and inundation. **Dan Cayan** (USGS, Scripps Institution of Oceanography, Intergovernmental Panel on Climate Change [IPCC] Working Group II, and National Research Council Committee for Sea Level Rise in California, Oregon, and Washington) presented predicted temperatures and sea-level-rise scenarios based on a suite of global climate models. **Peter Bromirski** (Scripps Institution of Oceanography) presented results of using global-climate-model wind forcing to hindcast (that is, test model outputs against past conditions) and forecast wave heights and periods for California. **David Jay** (Portland State University) showed how sea-level rise has affected the tidal constituents and tidal range along the U.S. west coast and how climate change may be affecting the position of tidal amphidromes (nodal points) in the Pacific Ocean. **Xiaochun Wang** (National Aeronautics and Space Administration [NASA] Jet Propulsion Laboratory) showed how Regional Ocean Modeling System (ROMS) modeling in the eastern North Pacific Ocean has identified the temporal and spatial variability of mesoscale (typically 1 to 100 kilometers in horizontal extent) circulation patterns affecting upwelling and downwelling—and thus water levels—along the coast of California. **Jerry Weber** (University of California, Santa Cruz, emeritus) provided insight on the local geologic setting and its role in controlling relative sea-level trends and coastal change, and he linked the distribution of rock types along the coast to a differential potential for shoreline erosion under predicted future sea levels. Workshop participants also included **Li Erikson** (USGS-PCMSC) and researchers from the Monterey Bay Aquarium Research Institute (MBARI), University of California Davis' Bodega Marine Laboratory, National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center, NOAA National Marine Sanctuary Program, NOAA Pacific Marine Environmental Laboratory, California State Coastal Conservancy, and ESA Associates.

In the afternoon, the participants determined that despite the wealth of information on the relevant processes, we still do not have sufficient information to provide reasonable estimates of future sea-level rise and inundation along the central California coast. The group outlined some specific needs for information—for example, downscaling the global climate models to provide kilometer-scale output offshore of the California coast, and then using those results to drive regional wave models; acquiring nearshore morphology on which

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(Coastal Change continued from page 16)

to project waves and model inundation; and monitoring coastal response to storms in order to build datasets for calibrating and validating numerical models of inundation and coastal change. The group then summarized these points and set the future goals of (1) drafting a white paper summarizing the new information (and associated gaps in knowledge) that was presented at the workshop, along with additional input from scientists who could not attend the workshop but wanted to contribute; (2) presenting the white paper and workshop information on the COS website (**http://www.centerforoceansolutions.org/**); and (3) organizing a follow-on meeting where the conveners would help disseminate this new information and the associated gaps in knowledge to federal, state, and local governments, in addition to research institutions and nonprofit organizations, for planning future science and management efforts. ☸

Awards

James V. Gardner, 2012 Shepard Medalist for Excellence in Marine Geology

The Society for Sedimentary Geology (SEPM) awarded its 2012 Francis P. Shepard Medal for Marine Geology to ***James V. Gardner****, emeritus senior geologist with the U.S. Geological Survey (USGS) and research professor at the University of New Hampshire, "in recognition of his extraordinary scientific career providing insight into marine geologic processes, his leadership in application of advanced technology to seafloor research, and his unprecedented contributions to mapping the geologic landscape of America's marine domain." The medal was presented on April 24, 2012, at the SEPM Annual Meeting in Long Beach, California. Below is a biography of* ***Jim*** *written for the occasion by his colleague* ***Michael E. Field****, senior research scientist at the USGS Pacific Coastal and Marine Science Center in Santa Cruz, California.*

Jim Gardner *(right), USGS emeritus senior geologist, receives the Francis P. Shepard Medal for Marine Geology from* ***Chris Fielding****, president of the Society for Sedimentary Geology (SEPM) on April 24, 2012, at the SEPM Annual Meeting in Long Beach, California.*

It is indeed fitting that SEPM honors **Jim Gardner** with the Francis P. Shepard Medal for Marine Geology at this meeting, set alongside the California Continental Borderland, the home and research haunt of **Fran Shepard**. **Fran** loved nothing more than a good geologic map of the ocean floor and a solid scientific revelation of its meaning. **Jim** delivered both, over and over, and in so doing, he has had immeasurable impact on a generation of marine geologists through his distinguished career with the U.S. Geological Survey and with the University of New Hampshire.

Jim hails from Kansas, far from the sea (at least the present-day one), and he started his undergraduate studies there before heading west to San Diego State University to complete them and begin a lifetime association with the ocean. His Ph.D. research was at Columbia University's Lamont Geological Observatory in the late 60s and early 70s, one of the most exciting places for marine research on the planet. He immediately launched into a long and successful research career spanning the globe, leading cruises aboard the Deep Sea Drilling Program's (DSDP) drillship *Glomar Challenger*, and dozens of U.S. and foreign oceanographic research vessels, addressing such diverse topics as seafloor evolution, modern marine geological processes, and Quaternary paleoclimate and marine facies.

But it is **Jim's** lasting contributions to marine geology through his large, innovative programs to map the U.S. seafloor, *in detail and in its entirety*, for which we particularly honor him. In 1983 the United States established the 200 mile-wide Exclusive Economic Zone (EEZ), and **Jim** responded with a plan to combine the unique wide-swath sonar system (Geological Long-Range Inclined Asdic, or GLORIA) of the United Kingdom with software developed by the United States

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(Shepard Medal continued from page 17)

for planetary exploration. This combination provided, for the first time, accurate, detailed seafloor maps of the entire U.S. EEZ. Under **Jim's** guidance, he and his colleagues mapped new volcanoes off California, turbidite pathways in the Gulf of Mexico, giant landslides off Hawai‘i, enormous canyons off Alaska, and a host of other features and processes never before imaged or even imagined. The monumental results were published widely as journal papers, USGS reports and atlases, and in the landmark book *Geology of the United States' Seafloor: The View from GLORIA*. The GLORIA seafloor-mapping program was unprecedented in its scope or achievement—a direct reflection of **Jim's** scientific vision and leadership.

High-resolution multibeam bathymetric mapping made its debut in the 1990s, and once again **Jim's** contributions rose to a level of prominence and distinction. Working closely with **Larry Mayer**, first at the University of New Brunswick and then at the University of New Hampshire, he became a leader in the new science of marine geology exploration and interpretation using high-resolution maps of the seafloor. He mapped the U.S. continental margins to identify fish habitats, coastal hazards, geologic structures, and active sediment processes. The maps that **Jim** produced and interpreted—from San Francisco Bay and Puget Sound, to Lake Tahoe and Crater Lake, to the Gulf of Mexico and beyond—line the hallways of academic and government institutions. His latest ventures include new, groundbreaking maps of the U.S. seafloor off Alaska, the Northern Mariana Islands, and the Atlantic margin. And when he isn't mapping some distant unknown piece of Planet Ocean, **Jim** can be found chasing rainbow trout across New England or traveling the globe with his lovely and talented wife and daughters.

Jim Gardner has mapped more of the U.S. seafloor than any other person, and he has published maps and geological interpretations that have provided a wealth of information for scientists and resource managers alike. He is indeed most deserving of recognition through SEPM's Shepard Medal for his unique and selfless contributions in seafloor mapping and research for a generation of marine geologists. **Fran Shepard** would be proud to have such an accomplished and distinguished scientist receive the award established in his name. ☸

Staff and Center News

Team MarFac Completes Century Bicycle Ride

By Gerry Hatcher

On Sunday, May 20, 2012, “Team MarFac” from the Marine Facility at the U.S. Geological Survey (USGS) Pacific Coastal and Marine Science Center in Santa Cruz, California, completed the Strawberry Fields Forever Bike Ride, an annual bicycle ride sponsored by Cyclists for Cultural Exchange (**http://www.strawberryfields.org/**).

Team MarFac cyclists rode either the 100-kilometer route with 4,400 feet of climbing or the 100-mile route with 8,275 feet of climbing! Everyone finished in good spirits with no major mechanical problems (bikes or bodies).

It's good to know that your coworkers at MarFac—who are responsible for taking you, your equipment, and your science into the field—are no couch potatoes! ☸

(Left to right) ***Gerry Hatcher, Peter Harkins, Pete Dal Ferro, Rob Wyland, Jenny White,*** *and* ***Jackson Currie*** *of the USGS, and* ***Pete Dal Ferro's*** *wife,* ***Melissa Foley****.*

Recently Published Articles

Anderson, T., Rosenberger, K.J., and Gartner, A.L., 2012, Reformatted data sets used in the Cooperative LACSD/USGS Palos Verdes Flow Study, 2000–2008: U.S. Geological Survey Open-File Report 2010–1253, 45 p. [**http://pubs.usgs.gov/of/2010/1253/**].

Cimitile, M.J., and Boynton, B., 2012, Vibracoring; reconstructing Earth's past from sediments: U.S. Geological Survey video podcast [**http://coastal.er.usgs.gov/podcast/**].

Fleskes, J.P., Wetlands of the Central Valley and Klamath Basin, 2012, chap. 25 *of* Batzer, D.P., and Baldwin, A.H., eds., Wetland habitats of North America: Berkeley, University of California Press, ISBN: 9780520271647 [**http://www.ucpress.edu/book.php?isbn=9780520271647**].

Franks, S.E., Norris, D.R., Kyser, T.K., Fernández, G., Schwarz, B., Carmona, R., Colwell, M.A., Sandoval, J.C., Dondua, A., Gates, H.R., Haase, B., Hodkinson, A.J., Lanctot, R.B., Ortego, B., Sandercock, B.K., Sanders, F., Takekawa, J.Y., Warnock, N., Ydenberg, R.C., and Lank D.B., 2012, Range-wide patterns of migratory connectivity in the western sandpiper *Calidris mauri*: Journal of Avian Biology, v. 43, no. 2, p. 155–167, doi:10.1111/j.1600-048X.2012.05573.x [**http://dx.doi.org/10.1111/j.1600-048X.2012.05573.x**].

Friess, D.A., Krauss, K.W., Horstman, E.M., Balke, T., Bouma, T.J., Gallie, D., and Webb, E.L., 2012, Are all intertidal wetlands naturally created equal? Bottlenecks, thresholds and knowledge gaps to mangrove saltmarsh ecosystems: Biological Reviews, v. 87, no. 2, p. 346–366, doi:10.1111/j.1469-185X.2011.00198.x [**http://dx.doi.org/10.1111/j.1469-185X.2011.00198.x**].

Hapke, C.J., 2012, Coastal dynamics at Fire Island; connecting inner shelf geology, processes, and trends of shoreline change [abs.]: Fire Island National Seashore Planning, Science and Research Conference, 8th Biennial, Patchogue, N.Y., April 27–28, 2012 [**http://www.nps.gov/fiis/scienceconference.htm**].

Hechinger, R.F., Lafferty, K.D., and Kuris, A.M., 2011, Parasites, *in* Sibley, R.M., Brown, J.H., and Brown, A. (eds.), Metabolic ecology; a scaling approach: Hoboken, N.J., Wiley-Blackwell, p. 234–247 [**http://onlinelibrary.wiley.com/book/10.1002/9781119968535**].

Herring, G., Ackerman, J.T., and Herzog, M.P., 2012, Mercury exposure may suppress baseline corticosterone levels in juvenile birds: Environmental Science and Technology, v. 46, no. 11, p. 6339–6346, doi:10.1021/es300668c [**http://dx.doi.org/10.1021/es300668c**].

Holmes, R.R., Jr., Jones, L.M., Eidenshink, J.C., Godt, J.W., Kirby, S.H., Love, J.J., Neal, C.A., Plant, N.G., Plunkett, M.L., Weaver, C.S., Wein, A., and Perry, S.C., 2012, Natural hazards science strategy—public review release: U.S. Geological Survey Open-File Report 2012–1088, 75 p. [**http://pubs.usgs.gov/of/2012/1088/**].

Kinsman, N., and Xu, J.P., 2012, Fluorescent tracer experiment on Holiday Beach near Mugu Canyon: U.S. Geological Survey Open-File Report 2012–1131 [**http://pubs.usgs.gov/of/2012/1131/**].

Krauss, K.W., and Whitbeck, J.L., 2012, Soil greenhouse gas fluxes during wetland forest retreat along the lower Savannah River, Georgia (USA): Wetlands, v. 32, no. 1, p. 73–81, doi:10.1007/s13157-011-0246-8 [**http://dx.doi.org/10.1007/s13157-011-0246-8**].

Kuffner, I.B., Paul, V.J., Ritson-Williams, R., Hickey, T.D., and Walters, L.J., 2012, Baseline surveys to detect trophic changes in shallow hard-bottom communities induced by the Dry Tortugas National Park Research Natural Area, chap. 8 *of* Ziegler, T.A., and Hunt, J., eds., Implementing the Dry Tortugas National Park Research Natural Area science plan; the 5-year report: Tallahassee, Fla., National Park Service and Florida Fish and Wildlife Conservation Commission, p. 42–45 [**http://www.nps.gov/ever/naturescience/upload/DRTORNA5YrFINALComplete04092012LoRes.pdf**, 8.8 MB]

McKee, K.L., 2012, Nutrient impacts on wetlands; field studies, New Zealand: U.S. Geological Survey video, USGS Multimedia Gallery [**http://gallery.usgs.gov/videos/540**].

McKee, K.L., and Grace, J.B., 2012, Effects of prescribed burning on marsh-elevation change and the risk of wetland loss: U.S. Geological Survey Open-File Report 2012–1031, 51 p. [**http://pubs.usgs.gov/of/2012/1031/**].

Middleton, B.A., 2010, Old data, new problems: Society of Wetland Scientists Brief no. 2010-0002, 4 p. [**http://www.sws.org/ResearchBrief/**].

Miselis, J.L., Holland, K.T., Reed, A.H., and Abelev, A., 2012, Use of vertical temperature gradients for prediction of tidal flat sediment characteristics: Journal of Geophysical Research, v. 117, C03012, 10 p., doi:10.1029/2011JC007566 [**http://dx.doi.org/10.1029/2011JC007566**].

Morrison, G., Greening, H.S., and Yates, K.K., 2011, Management case study; Tampa Bay, Florida, *in* Wolansky, E., McLuskey, D.S., Kremer, H., and Pinckney, J., eds., Treatise on estuarine and coastal science, v. 11: New York, Elsevier, p. 31–76.

Muzaffar, S.B., Hill, N.J., Takekawa, J.Y., Perry, W.M., Smith, L.M., and Boyce, W.M., 2012, Role of bird movements in the epidemiology of West Nile and avian influenza virus: Human-Wildlife Interactions, v. 6, no. 1, p. 72–88 [**http://www.werc.usgs.gov/ProductDetails.aspx?ID=4695**].

Oze, C., Jones, L.C., Goldsmith, J.I., and Rosenbauer, R.J., 2012, Differentiating biotic from abiotic methane genesis in hydrothermally active planetary surfaces: Proceedings of the National Academy of Sciences (PNAS), v. 109, no. 25, p. 9750–9754, doi:10.1073/pnas.1205223109 [**http://dx.doi.org/10.1073/pnas.1205223109**].

Ramsey, E.W., III, and Rangoonwala, A., 2012, Hyperspectral remote sensing of wetland vegetation, chap. 21 *of* Thenkabail, P.S., Lyon, J.G., and Huete, A., eds., Hyperspectral remote sensing

(Recently Published continued on page 20)

(Recently Published continued from page 19)

of vegetation: Boca Raton, Fla., London, and New York, CRC Press, p. 487–511.

Ramsey, E.W., III, Werle, D., Suzuoki, Y., Rangoonwala, A., and Lu, Z., 2012, Limitations and potential of satellite imagery to monitor environmental response to coastal flooding: Journal of Coastal Research, v. 28, no. 2, p. 457–476, doi:10.2112/JCOASTRES-D-11-00052.1 [**http://dx.doi.org/10.2112/JCOASTRES-D-11-00052.1**].

Ringelman, K.M., Eadie, J.M., Ackerman, J.T., 2012, Density-dependent nest predation in waterfowl; the relative importance of nest density versus nest dispersion: Oecologia, v. 169, no. 3, p. 695–702, doi:10.1007/s00442-011-2228-1 [**http://dx.doi.org/10.1007/s00442-011-2228-1**].

Robbins, L., 2012, Studying ocean acidification in the Arctic Ocean: U.S. Geological Survey Fact Sheet 2012-3058, 2 p. [**http://pubs.usgs.gov/fs/2012/3058/**].

Roderick, G., Croucher, P., Vandergast, A., and Gillespie, R., 2012, Species differentiation on a dynamic landscape; shifts in metapopulation genetic structure using the chronology of the Hawaiian Archipelago: Evolutionary Biology, v. 39, no. 2, p. 192–206, doi:10.1007/s11692-012-9184-5 [**http://dx.doi.org/10.1007/s11692-012-9184-5**].

Rosenbauer, R.J., Thomas, B., Bischoff, J.L., and Palandri, J., 2012, Carbon sequestration via reaction with basaltic rocks; geochemical modeling and experimental results: Geochimica et Cosmochimica Acta, v. 89, p. 116–133, doi:10.1016/j.gca.2012.04.042 [**http://dx.doi.org/10.1016/j.gca.2012.04.042**].

Smith, C.G., Marot, M.E., and Osterman, L.E., 2012, Influence of anthropogenic activities and natural processes on historic depositional patterns and environmental change in the Mobile Bay estuarine system (USA) [abs.]: Ocean Sciences Meeting, Salt Lake City, Utah, February 20–24, 2012 [**http://www.sgmeet.com/osm2012/viewabstract2.asp?AbstractID=10370**].

Stefanova, L., Misra, V., Chan, S., Griffin, M., O'Brien, J.J., and Smith, T.J., III, 2012, A proxy for high-resolution regional reanalysis for the Southeast United States; assessment of precipitation variability in dynamically downscaled reanalyses: Climate Dynamics, v. 38, no. 11–12, p. 2449–2466, doi:10.1007/s00382-011-1230-y [**http://dx.doi.org/10.1007/s00382-011-1230-y**].

Stockdon, H.F., Doran, K.S., Thompson, D.M., Sopkin, K.L., Plant, N.G., and Sallenger, A.H., 2012, National assessment of hurricane-induced coastal erosion hazards; Gulf of Mexico: U.S. Geological Survey Open-File Report 2012–1084, 51 p. [**http://pubs.usgs.gov/of/2012/1084/**].

Strona, G., and Lafferty, K.D., 2012, How to catch a parasite—Parasite Niche Modeler (PaNic) meets FishBase: Ecography, v. 35, no. 6, p. 481–486, doi:10.1111/j.1600-0587.2012.07439.x [**http://dx.doi.org/10.1111/j.1600-0587.2012.07439.x**].

Subino, J.A., Forde, A.S., Dadisman, S.V., Wiese, D.S., and Calderon, K., 2012, Archive of digital boomer seismic reflection data collected offshore east-central Florida during USGS cruises 96FGS01 and 97FGS01 in November of 1996 and May of 1997: U.S. Geological Survey Data Series 652, 2 DVDs [**http://pubs.usgs.gov/ds/652/**].

Subino, J.A., Forde, A.S., Dadisman, S.V., Wiese, D.S., and Calderon, K., 2012, Archive of digital boomer seismic reflection data collected offshore northeast Florida during USGS cruise 02FGS01, October 2002: U.S. Geological Survey Data Series 653, DVD [**http://pubs.usgs.gov/ds/653/**].

Subino, J.A., Morgan, K.L.M., Krohn, M.D., Miller, G.K., Dadisman, S.V., and Forde, A.S., 2012, Archive of post-Hurricane Charley coastal oblique aerial photographs collected during U.S. Geological Survey field activity 04CCH01 from Marco Island to Fort DeSoto, Florida, August 15, 2004: U.S. Geological Survey Data Series 651, 2 DVDs [**http://pubs.usgs.gov/ds/651/**].

Tanaka, A., Ohtani, M., Suyama, Y., Inomata, N., Tsumura, Y., Middleton, B.A., Tachida, H., and Kusumi, J., 2012, Population genetic structure of a widespread coniferous tree, *Taxodium distichum* [L.] Rich. (Cupressaceae), in the Mississippi River Alluvial Valley and Florida: Tree Genetics and Genomes, Online First, September 21, 2011, doi:10.1007/s11295-012-0501-z [**http://dx.doi.org/10.1007/s11295-012-0501-z**].

ten Brink, U.S., and Lopez-Venegas, A.M., 2012, Plate interaction in the NE Caribbean subduction zone from GPS observations: Geophysical Research Letters, v. 39, L10304, 6 p., doi:10.1029/2012GL051485 [**http://dx.doi.org/10.1029/2012GL051485**].

Twichell, D., Kelso, K., and Pendleton, E., 2012, Evidence for mid-Holocene change in depositional style in Mobile Bay, Alabama: U.S. Geological Survey Open File Report 2012–1081, 31 p. [**http://pubs.usgs.gov/of/2012/1081/**].

Warrick, J.A., Hatten, J.A., Pasternack, G.B., Gray, A.B., Goni, M.A., and Wheatcroft, R.A., 2012, The effects of wildfire on the sediment yield of a coastal California watershed: Geological Society of America Bulletin, v. 124, no. 7/8, p. 1130–1146, doi:10.1130/B30451.1 [**http://dx.doi.org/10.1130/B30451.1**].

Warrick, J.A., Rosenberger, K., Lam, A., Ferreira, J., Miller, I.M., Rippy, M., Svejkovsky, J., and Mustain, N., 2012, Observations of coastal sediment dynamics of the Tijuana Estuary Fine Sediment Fate and Transport Demonstration Project, Imperial Beach, California: U.S. Geological Survey Open-File Report 2012–1083, 29 p. and data files [**http://pubs.usgs.gov/of/2012/1083/**].

Welch, A.J., Fleischer, R.C., James, H.F., Wiley, A.E., Ostrom, P.H., Adams, J., Duvall, F., Holmes, N., Hu, D., Penniman, J., and Swindle, K.A., 2012, Population divergence and gene flow in an endangered and highly mobile seabird: Heredity, v. 109, p. 19–28, doi:10.1038/hdy.2012.7 [**http://dx.doi.org/10.1038/hdy.2012.7**].

Zhang, K., Liu, H., Li, Y., Xu, H., Shen, J., Rome, J., and Smith, T.J., III, 2012, The role of mangroves in attenuating storm surges: Estuarine, Coastal and Shelf Science, v. 102–103, p. 11–23, doi:10.1016/j.ecss.2012.02.021 [**http://dx.doi.org/10.1016/j.ecss.2012.02.021**].

Publications Submitted for Bureau Approval

Barnard, P.L., Foxgrover, A., Elias, E., Erikson, L.H., Hein, J.R., McGann, M., Rosenbauer, R., Runtzel, K., Swarzenski, P., Takesue, R., Wong, F., and Woodrow, D., Synthesis of bed characteristics, geochemical tracers, in situ measurements and numerical modeling for assessing the provenance of beach sand in the San Francisco Bay coastal system [abs.]: Bay-Delta Science Conference, 7th Biennial, Sacramento, Calif., October 16–18, 2012.

Brothers, L.L., Kelley, J.T., Belknap, D.F., Barnhardt, W.A., Andrews, B.D., Legere, C., and Hughes Clarke, J., North temperate estuarine pockmark fields; high-resolution geophysical and vibracore results from the Gulf of Maine and Bay of Fundy: Marine Geology.

Carkin, B.A., and Kayen, R., Settlement of the USS *Arizona*, Pearl Harbor, Hawaii: U.S. Geological Survey Scientific Investigations Report.

Dartnell, P., Finlayson, D.P., Ritchie, A., Cochrane, G.R., and Erdey, M.D., Bathymetry and acoustic backscatter—outer mainland shelf, eastern Santa Barbara Channel, California: U.S. Geological Survey Data Series.

Draut, A.E., Redsteer, M.H., and Amoroso, L., Vegetation, substrate, and aeolian sand transport at Teesto Wash, Navajo Nation, 2009 to 2012: U.S. Geological Survey Scientific Investigations Report.

Foxgrover, A.C., and Barnard, P.L., Surface sediment characteristics of the San Francisco Bay coastal system [abs.]: Bay-Delta Science Conference, 7th Biennial, Sacramento, Calif., October 16–18, 2012.

Galkiewicz, J.P., Stellick, S.H., Gray, M.A., and Kellogg, C.A., Cultured fungal associates from the deep-sea coral *Lophelia pertusa*: Deep-Sea Research Part I.

Gray, M.A., Pratte, Z.A., and Kellogg, C.A., Comparison of DNA preservation methods for environmental bacterial-community samples: FEMS Microbiology Ecology.

Lacy, J.R., and MacVean, L.J., Sediment dynamics in the shallows of San Francisco Bay [abs.]: Bay-Delta Science Conference, 7th Biennial, Sacramento, Calif., October 16–18, 2012.

Lentz, E., Hapke, C., Stockdon, H.F., and Hehre, R., Improving understanding of long-term barrier island evolution through multi-decadal assessment of morphologic change: Marine Geology.

Long, J.W., and Plant, N.G., Extended Kalman filter framework for forecasting shoreline evolution: Geophysical Research Letters.

McGann, M., Agglutinated foraminifera *Trochammina hadai* Uchio in San Francisco Bay, USA; dominance less than two decades after its introduction [abs.]: International Workshop on Agglutinated Foraminifera, 9th, Zaragoza, Spain, September 3–7, 2012.

McMullen, K.Y., Poppe, L.J., Ackerman, S.D., Worley, C.R., Nadeau, M.A., and Van Hoy, M.V., Sea-floor geology in central Rhode Island Sound south of Sakonnet Point, Rhode Island: U.S. Geological Survey Open-File Report 2012-1004.

Plant, N.G., and Stockdon, H.F., Probabilistic prediction of barrier-island response to hurricanes: Journal of Geophysical Research.

Poppe, L.J., Danforth, W.W., McMullen, K.Y., Blankenship, M.A., Glomb, K.A., Wright, D.B., and Smith, S.M., Sea-floor character and sedimentary processes of Block Island Sound: U.S. Geological Survey Open-File Report 2012-1005.

Renault, L., Chiggiato, J., Warner, J.C., Vizoso, G., Ruiz, S., Gomez, M., and Tintore, J., Coupled Atmosphere-Ocean-Wave simulations of a storm event over the Gulf of Lion and Balearic Sea: Journal of Geophysical Research–Oceans.

Stevens, A.W., Gelfenbaum, G., Kaminsky, G.M., and Ruggiero, P., Southwest Washington littoral drift restoration; beach and nearshore morphological monitoring: U.S. Geological Survey Open-File Report.

Todd, B.J., Valentine, P.C., and Shaw, J., Shaded seafloor topography, Georges Bank, Funidan Channel, and Northeast Channel, Gulf of Maine: Geological Survey of Canada A-series Map, 9 sheets.